**Name of Organization:** Ohio State University/ USGS

**Type of Organization:** College or University

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**Project Title:** Fish Pathology as an Index of Risk and Remediation Success

**Project Category:** Contaminated Sediments

**Rank by Organization (if applicable):** 0

**Total Funding Requested ($):** 172,801 **Project Duration:** 2 Years

**Abstract:**

Recent research in the Black River has demonstrated that fish pathology and population age structure can be used as an index of ecosystem health and remediation success. The Ottawa River, a tributary to Maumee Bay, Lake Erie, has sediment heavily polluted with PCBs and PAHs. We completed a survey of the bullhead community last spring (1999), and have seen a high rate of lesions in preliminary data. This summer and fall (1999) an unnamed tributary at RM 6 was dredged and filled and about 3 additional acres of heavily contaminated sediment was capped. We propose a second survey in the spring of 2001 to check the health of the bullhead population and ascertain what changes have occurred since the remediation. Data would include a detailed listing of external lesions, liver and external neoplasms, macrophage centers, bile metabolites, and vitellogenin analysis. Data would be shared with studies conducted by Hull and Associates and the Ohio EPA on benthic invertebrates and sediment. Data and conclusions would also be shared with the Maumee RAP. In the Cuyahoga River a survey in 1999 revealed that some carcinogen hot spots probably remain in sediment off the main shipping channel, such as the dead-end arm near the mouth. Fish from these areas had higher tumor rates than those from Black or Huron Rivers. We propose a more intensive survey in the spring of 2001 to detail the sediment PAH composition and discriminate areas with elevated tumor prevelance. Sediment samples would be taken from the arm (5 stations) and the area upstream of channel dredging (5 stations). Fish data would again include external and internal lesions and tumors, macrophage centers, vitellogenin analysis, and bile metabolites. Results would be compared to historical data from the 1980s and 1999 (still in analysis) and would be combined on a single data base available to researchers and regulatory agencies. Data and conclusions would be shared with the Cuyahoga River RAP.

**Geographic Areas Affected by the Project**

**States:**

- ☐ Illinois
- ☐ Indiana
- ☐ Michigan
- ☐ Minnesota
- ☐ New York
- ☐ Pennsylvania
- ☐ Wisconsin
- ☒ Ohio

**Lakes:**

- ☐ Superior
- ☐ Huron
- ☐ Michigan
- ☒ Erie
- ☐ Ontario
- ☐ All Lakes

**Geographic Initiatives:**

☐ Greater Chicago ☐ NE Ohio ☐ NW Indiana ☐ SE Michigan ☐ Lake St. Clair

**Primary Affected Area of Concern:** Cuyahoga River, OH

**Other Affected Areas of Concern:** Maumee River, OH (Ottawa River)

***For Habitat Projects Only:***

**Primary Affected Biodiversity Investment Area:**

**Other Affected Biodiversity Investment Areas:**

**Problem Statement:**

Cuyahoga River

The Cuyahoga River has had a history of PAH contaminated sediment and elevated external and liver tumors in brown bullhead. These were among the reasons the river has been designated as an area of concern. The current Lake Erie LaMP lists the Cuyahoga as having an unacceptably high level of neoplasms in fish. Several coking plants, the primary sources of PAH in the system, have closed in the last two decades. However no major remediation effort has been carried out. A fish survey by the USGS last summer (1999) revealed that the grossly visible tumor prevalence in brown bullhead from the Cuyahoga was still elevated, and that tumor frequency varied by location within the system. Liver histopathology and bile metabolite analysis are still in progress on these fish. A more detailed tumor and sediment survey could help develop a hotspot management plan.

Ottawa River

The Ottawa River is one of the most polluted streams in Ohio with both PCB and PAH contamination. A survey by the USGS last year (1999) documented a high prevalence of external lesions in brown bullhead from this system. Liver histology and bile metabolite analysis are still in progress on these fish. Since that survey a highly polluted tributary has been dredged and filled and an adjoining 3 acre area has been capped using three different techniques and layered substances, all of which have bentonite as the main seal. A second survey in spring 2001 would document any response to the remediation already accomplished, and would assess the health of fish from a representative area of the river. This data would help regulators determine if any further remediation is needed on the system.

**Proposed Work Outcome:**

Cuyahoga River

Sediment Chemistry

A large portion of the Cuyahoga is regularly dredged for shipping accesss. However a side arm near the mouth and a strech of river upstream of the dredged area both may contain fine sediments with concentrations of contaminants. These areas may also be attractive to benthic fish such as bullheads, since they provide relatively shallow, fine sediment foraging areas with more cover than is available in areas which are dredged regularly. We plan to sample five locations within each of these river areas, collecting surficial sediment using an Eckman or small Ponar dredge. If help could be obtained from the RV Mudpuppy's vibracorer, we would collect core samples instead, and add additional funds for analysis of 2 to 4 depth layers. Samples will be analyzed for PCB aroclors and PAH parent compounds using the US EPA approved protocol.

Fish Histopathology and Biochemistry

Brown bullhead will be collected from both study locations using over night sets of fyke nets. Fish of 250mm or greater in length will be collected, anesthetised, and sacrificed, weighed and measured. Two weeks will be scheduled for sampling to maximize the possibility of obtaining at least 50 bullhead from each location. Up to 80 fish from each location will be processed if caught. External lesions and tumors will be recorded in detail and examples will be preserved for histopathology. Livers will be examined and preserved for histopathology. A section of liver will be frozen for vitellogenin analysis, and bile will be collected for metabolite analysis for twenty fish from each location. All fish will be aged using pectoral spines. Comparisons between stations and with historical data from the Cuyahoga and other systems will be made on an age-specific basis using different lesions from different tissue types (skin, liver, bile duct), and stages of development (cellular alteration, neoplasm, cancer). Bile metabolites will be measured for benzo(a)pyrene and naphthalene and compared to values from other systems.

Ottawa River

Fish Histopathology and Biochemistry

Fish will be caught near the newly capped area and from reaches upstream and downstream by overnight set of fyke nets. We will spend up to eight days on the system to ensure the capture of at least 50 fish, and will process up to 80 fish if caught. Fish of 250mm or greater will be anesthetized, sacrificed, weighed, measured, and necropsied. External lesions will be recorded in detail and samples will be preserved for histopathology. The internal organs will be examined for gross lesions, and the the liver will be preserved for histopahology. A piece of the liver will also be frozen for vitellogenin analysis and bile will be collected for metabolite analysis from 20 fish. All fish will be aged using pectoral spines. Lesions will be catagorized by tissue type and by stage of progression on an age specific basis. Prevalence of lesions will be compared to the pre-remediation survey and to historical data from other Great Lakes tributaries. Bile will be analyzed for both benzo(a)pyrene and naphthalene metabolites.

| Project Milestones: | Dates: |
|---|---|
| QUAPP | 09/2000 |
| Selection of Specific Study Locations | 10/2000 |
| Field Sampling on the Cuyahoga | 05/2001 |
| Field Sampling on the Ottawa | 06/2001 |
| Analytical Chemistry Results | 10/2001 |
| Fish Histopathology Results | 12/2001 |
| Data Analysis | 06/2002 |
| Final Report | 09/2002 |

☒ Project Addresses Environmental Justice

**If So, Description of How:**

Both the Cuyahoga and Ottawa Rivers support a local fishery. However most middle or upper class fishermen can afford the mid to large sized boats needed to fish Lake Erie proper, and do not fish in these rivers. Thus the fishery consists largely of the urban poor, including children. These people are the most likely group to keep benthic fish such as bullheads and to consume such fish as a significant portion of the family diet. They are also often the hardest group to reach with information about contaminants and health risks. Since this group uses the fish as family meals (as opposed to adult male fishing vacations), the most risk sensative groups, such as pregnant women and children are exposed. Our project would help define this risk and would help inform those using these fish as food of the risk through news releases, presentations, and personal contact.

☒ Project Addresses Education/Outreach

**If So, Description of How:**

Two graduate students theses will be supported by this project. The results will be published in peer- reviewed journal articles and presented at regional and national scientific meetings. Presentations and /or reports will be given to the Remedial Action Committees for the Maumee and Cuyahoga Areas of Concern, as well as to the Beneficial Use Impairment Committee of the Lake Erie LaMP. Results will also be summarized and sent to those developing indicators of ecosystem health in the Great Lakes for SOLEC.

**Project Budget:**

| | Federal Share Requested ($) | Applicant's Share ($) |
|---|---|---|
| **Personnel:** | 75,386 | 33,925 |
| **Fringe:** | 714 | 6,800 |
| **Travel:** | 9,752 | 0 |
| **Equipment:** | 0 | 0 |
| **Supplies:** | 5,000 | 0 |
| **Contracts:** | 26,700 | 0 |
| **Construction:** | 0 | 0 |
| **Other:** | 0 | 0 |
| **Total Direct Costs:** | 117,552 | 40,725 |
| **Indirect Costs:** | 55,249 | 0 |
| **Total:** | 172,801 | 40,725 |
| **Projected Income:** | 0 | 0 |

**Funding by Other Organizations (Names, Amounts, Description of Commitments):**

The salary of the Principal Investigator will be paid by the Biological Resources Division of the USGS. Similary boats, motors, vehicles, fuel for vehicles, and nets will be supplied by the USGS. Some additional technician help up to $2,000 will be paid by the State of Ohio and/or The Ohio State University.

**Description of Collaboration/Community Based Support:**

Field support will be needed from GLNPO and its contractors if the R/V Mudpuppy is used to take core samples from the Cuyahoga River. Information and field assisstance will be shared with the Maumee River RAP organization and the Ohio EPA.